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# मानक

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IS 11947 (1987): Soft magnetic iron rods, bars, flats and sections [MTD 16: Alloy Steels and Forgings]



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Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”



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*Indian Standard*

SPECIFICATION FOR  
SOFT MAGNETIC IRON RODS, BARS,  
FLATS AND SECTIONS

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**BUREAU OF INDIAN STANDARDS**  
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG  
NEW DELHI 110002

# *Indian Standard*

## SPECIFICATION FOR SOFT MAGNETIC IRON RODS, BARS, FLATS AND SECTIONS

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# *Indian Standard*

## SPECIFICATION FOR SOFT MAGNETIC IRON RODS, BARS, FLATS AND SECTIONS

### 0. FOREWORD

**0.1** This Indian Standard was adopted by the Indian Standards Institution on 13 March 1987, after the draft finalized by the Special Alloys Sectional Committee had been approved by the Structural and Metals Division Council.

**0.2** This standard has been prepared for rationalizing the requirements of magnetic materials which are often referred to as 'Commercially Pure' or 'Magnetically Soft' irons. This material is generally available in a wide variety of forms, such as slabs, billets, ingots, forgings, hot rolled bars or as flat rolled sheets and strips.

**0.3** The main applications for these materials are in dc relays, loudspeakers, electro-magnets, magnetic clutches, brakes, parts for magnetic circuits in instruments and control apparatus as well as for pole pieces and other dc parts for generators and motors.

**0.4** For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS:2-1960\*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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### 1. SCOPE

**1.1** This standard covers the requirements of cold drawn soft magnetic iron rods, bars, flats and sections primarily intended for electro-magnetic applications, such as relay, cores, etc, of electrical machinery and apparatus.

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\*Rules for rounding off numerical values (*revised*).

## 2. SUPPLY OF MATERIAL

**2.1** General requirements relating to the supply of cold drawn soft magnetic iron rods, bars, flats and sections shall conform to IS:1387-1967\* and IS:8910-1978†.

**2.2** Rods shall be supplied either in the form of coils or in straight lengths, and this shall be subject to mutual agreement between the purchaser and the manufacturer.

## 3. MANUFACTURE

**3.1** Unless otherwise agreed to in the order, the manufacturing process shall be left to the discretion of the manufacturer.

## 4. CHEMICAL COMPOSITION

**4.1** The product analysis of the material, when carried out either by the methods specified in relevant part of IS:228‡ or any other established instrumental/chemical method, shall be as given in Table 1. In case of any dispute, the procedure given in relevant parts of IS:228‡ shall be the referee method.

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**TABLE 1 CHEMICAL COMPOSITION (TYPICAL VALUES)**

CONSTITUENT	PERCENT
Carbon	0.05
Silicon	0.20
Manganese	0.40
Sulphur	0.025
Phosphorus	0.025

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## 5. PHYSICAL CONDITIONS

**5.1** The material shall be in bright cold drawn and annealed condition.

**5.2** The material shall be uniform in composition and shall have uniform micro and macro structure, round, homogeneous, and free from physical defects or flaw both externally and internally.

**5.3** The rods, bars, flats and sections shall be smooth and flat and shall be straight and true, uniform in cross-section and free from physical

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\*General requirements for the supply of metallurgical materials (*first revision*).

†General technical delivery requirements for steel and steel products.

‡Methods for chemical analysis of steels (issued in various parts).



imperfections, such as pipes, segregations, seams, rakes, cold laps, scabs, etc.

**5.4** The surface of the rods, bars, flats and sections shall be bright, clean and smooth and shall be free from scale, rust, pittings, dirt or any other surface irregularities. The surface shall be suitable for electroplating.

**5.5** The flats shall possess smooth surfaces with square edges.

## 6. MECHANICAL PROPERTIES

**6.1 Tensile Strength** — The tensile strength of the material, when carried out in accordance with IS : 1608-1972\*, shall have a value of 280 MPa *Min.*

**6.2 Hardness** — The hardness of the material should be within the range 55-70 HRB, when determined in accordance with IS : 1586-1968†.

**6.3 Bend Test** — Bend test shall be carried out, only for flats, in accordance with IS : 1599-1985‡. The test piece shall be bent cold through 180°, having a close bend. The test piece shall be deemed to have passed the test, if the outer convex surface is free from cracks.

**NOTE** — If the purchaser requires the material in any other condition, such as 'quarter hard', 'half hard', etc, the mechanical properties shall be as agreed to between the contracting parties.

## 7. MAGNETIC PROPERTIES

**7.1 Coercive Force** — The coercive force shall be determined on a test piece after annealing at 800°C for 3 h under atmospheric conditions of controlled decarburization and cooling in the furnace at a maximum cooling rate of 60°C/h or as per manufacturer's recommendations. The annealed test piece shall be tested on a 'FORSTER TYPE' coercimeter or conventional ballastic/flux meter method. The value of the coercive force, after magnetizing to 16 000 Gauss shall not exceed 1.0 Oersted (0.8 A/cm).

**7.2 Ageing** — The difference between the measured value of the coercive force after ageing the specimen at  $100 \pm 5^\circ\text{C}$  for 300 h, and the initial value shall be less than 10 percent.

\* Method for tensile testing of steel products (*first revision*).

† Methods for rockwell hardness test (B and C scales) for steel (*first revision*).

‡ Method for simple bend-test (*second revision*).

**7.3 Magnetic Induction** — After annealing as per manufacturer's specification or at 800°C for 3 h and cooling slowly in the furnace at the rate of *Max* 60°C/h, the magnetizing curve must show the following minimum values:

<i>Field Strength</i>		<i>Induction</i>		<i>Field Strength</i>		<i>Induction</i>	
Oe	A/cm	Gauss	$\mu\text{VS}/\text{cm}^2$	Oe	A/cm	Gauss	$\mu\text{VS}/\text{cm}^2$
1.25	1	9 000	90	6.25	5	13 000	130
2.50	2	11 000	110	12.5	10	14 500	145
3.75	3	12 000	120	50	40	16 000	160

**7.4 Remanence** — After magnetizing with 16 000 Gauss (160  $\mu\text{VS}/\text{cm}^2$ ) the indicative value for the remanence is 11 000 Gauss.

## 8. DIMENSIONAL TOLERANCES

**8.1** Unless otherwise agreed to between the contracting parties, the dimensional tolerances shall be given in **8.2** to **8.8**.

### 8.2 Tolerances for Round Rods and Bars

<i>Nominal Diameter</i>		<i>Tolerance on Diameter</i>
Over	Up to and Including	
mm	mm	mm
—	6	$\pm 0.030$
6	10	$\pm 0.035$
10	15	$\pm 0.040$
15	30	$\pm 0.050$

### 8.3 Tolerances on Thickness for Rectangular Flats

<i>Thickness</i>		<i>Tolerance on Thickness</i>
Over	Up to and Including	
mm	mm	mm
—	3	$\pm 0.05$
3	6	$\pm 0.07$
6	15	$\pm 0.10$

**8.4 Tolerances on Width for Rectangular Flats**

<i>Width</i>		<i>Tolerance on Width</i>
Over	Up to and Including	
mm	mm	mm
—	6	$\pm 0.05$
6	10	$\pm 0.08$
10	30	$\pm 0.10$
30	50	$\pm 0.15$

**8.5 Tolerances for Sections** — Special sections like oval, etc, will have a tolerance as agreed to between the contracting parties.

**8.6 Tolerance on Length-for-Rods, Bars, Flats and Sections** — A tolerance of  $\pm 1$  percent on the length specified will be allowed. The extremities should be clean and free from burrs.

**8.7 Tolerance on Straightness of Bars** — When placed on a horizontal flat surface and loaded by their own weight only, the maximum deviation from the surface, between two points, at a distance of 1 metre from each other, should be within 1 mm.

**8.8 Tolerance on Out-of-Roundness** — Out-of-roundness is the difference between the maximum and the minimum diameters, measured at the same cross-section. It shall not be more than half of the tolerance on the diameter.

**9. MATERIAL ON COIL**

**9.1** Material intended for cold heading shall be supplied with an extrusion finish. The coils shall be in one continuous length and its eye diameter and weight shall be mutually agreed to between the manufacturer and the purchaser.

**10. SAMPLING FOR TESTS**

**10.1** One representative sample from a lot shall be taken for tensile testing and chemical analysis. A lot consists of 30 tonnes or less of the same quality drawn to the same diameter/section and condition. If the lot consists of more than one heat, samples from each heat shall be tested.

**10.2** For hardness, bend test and other magnetic properties, one sample from each lot of 5 tonnes or part thereof shall be taken.

## **11. RETEST**

**11.1** Should any of the test pieces first selected fail to pass any of the tests specified in this standard, two further samples shall be selected, from the same lot one of which shall be from the original strip or coil for testing in respect of each failure. Should the test pieces from both the additional samples pass, the material represented by the test samples shall be deemed to comply with the requirements of that particular test. Should the test pieces from each of these additional samples fail, the material represented by the test sample shall be deemed as not conforming to this standard.

## **12. PACKING**

**12.1** The material shall be treated with non-hardening type rust preventive oil, which can easily be washed with aqueous alkali solution.

**12.2** The material shall be well protected from damages and corrosion during transit. The bundle shall be wrapped with hessian water-proof cloth and tied with hoop iron. External packing shall be done by using strong wooden case or crates to prevent damages. The weight of each such case shall be mutually agreed to between the manufacturer and the purchaser.

## **13. MARKING**

**13.1** The following shall be legibly marked on the top of each bundle or package of strips or shown on a tag attached to each coil:

- a) Manufacturer's name and trade-mark;
- b) Quality/Grade designation;
- c) Product dimensions;
- d) Cast or identification mark by which the strip may be traced to cast or casts from which they are made;
- e) Net and gross weight; and
- f) Date of despatch.

**13.2** The material may also be marked with the Standard Mark.

**NOTE**—The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act 1986 and the Rules and Regulations made thereunder. The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.